Idaho Department of Fish and Game

Dworshak Reservoir Quarterly Report

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October, November, December, 2004

Inside this issue:

Figure 1. Dworshak Dam and Reservoir in winter.

Points of Interest:

- Dworshak Reservoir kokanee entrainment explained.
- Highest fish detection during nighttime periods. Highest detection rate ever observed, potential for high entrainment rate.
- Hydroacoustic transducer installed in turbine unit 2 to detect fish as they become entrained.
- October Kokanee densities near dam highest seen in three years, mostly fry.
- Preparing recommendation plan to permanently install underwater strobe lights as a measure to reduce fish entrainment.

Kokanee Entrainment Assessment

The term entrainment, in this context, is the active loss of fish out of the reservoir through the dam. At Dworshak Reservoir (Figure 1), the most abundant fish and therefore most entrained fish are kokanee. They are attracted and/or pulled into dam intakes and flushed out of the reservoir and into the river below. The cause for entrainment is not known, but one thought is that kokanee, although landlocked, are simply exhibiting residual migratory tendencies of their ancestors (Sockeye Salmon), and become attracted to flowing water. Another possibility is that kokanee accidentally wander near intakes and are literally sucked into the dam openings by fast water which they can't escape.

In some years fish entrainment can be catastrophic, such as during the flood of 1996 when 95% of the kokanee in the reservoir were entrained during a couple months. This was a rare event; however, even in low water years, the reservoir still loses thousands of fish. Therefore, our research is aimed at solving the problem of entrainment losses in order to stabilize the population to provide for a consistently productive fishery. Part of this research is our on-going entrainment monitoring using scientific sonar (hydroacoustic) equipment to detect fish near the intakes.

We sampled three 24-hour periods during October and December this quarter in front of turbine intakes , sampling was not conducted during November. This monthly monitoring provides basic information on the number of detected fish immediately in front of operating turbines and reservoir outlets (ROs), representative of fish vulnerability to entrainment. This information helps to predict the degree of variability in fish entrainment expected between time of day, seasons, discharge

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Table 1. Entrainment assessment sampling dates; turbine intakes, discharge (cubic feet per second), intake depth (feet) sampled, and detection rate of fish (number per hour), obtained from 24 hr sampling periods, July - October, 2004.

Date	Turbine #	Discharge (cfs)	Intake Depth (ft)	Detection (fish/hr)
7/21/04	1	2100	100	**0.2**
7/22/04	2	2100	97	**0.5**
8/5/04	3	5500	152	**1.1**
8/9/04	2	2200	66	**5.9**
8/10/04	1	2200	138	**0.3**
8/30/04	2	2000	70	**3.0**
8/31/04	3	5700	120	**1.8**
9/27/04	2	1600	100	**9.1**
10/4/04	1	1600	100	**21.5**
10/18/04	1	1600	100	**28.0**
10/19/04	1	1600	100	**40.8**

(Continued from page 1)

rate, and intake openings.

Fish detection rates increased dramatically during our sampling this quarter. Analysis of data collected during December with the newly installed transducer has not yet been completed, therefore we present October's data in comparison with the previous quarters results (Table 1).

Dworshak Dam operations were unchanged throughout October entrainment sampling, which is typical of the fall minimum discharge period. Water was only discharged through turbine unit one, at one withdrawal depth (100 feet), and at a constant discharge rate of only 1,600 cubic feet per second (cfs). Therefore, comparisons of the effect of discharge rate, depth, and turbine unit discharging on entrainment potential were not possible. However, we did observe very drastic differences in fish detection rates between the different time periods.

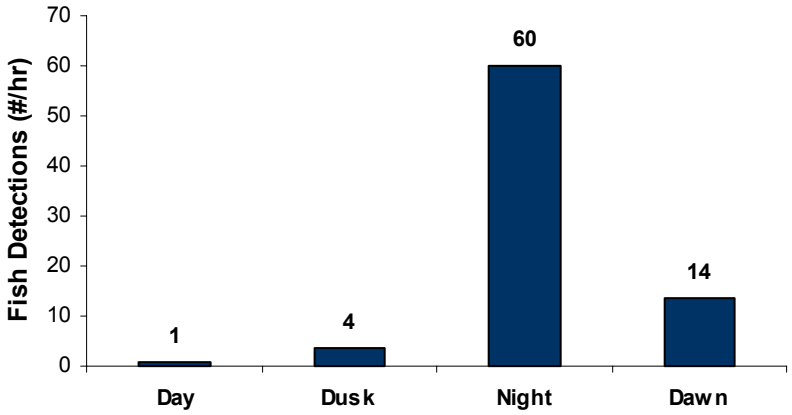


Figure 2. Mean fish detection rates (comparison between day, dusk, night, and dawn time periods) obtained from three 24 hour entrainment assessment sampling periods, October 4th, 18th, and 19th, 2004.

Again as we've seen in previous sampling, the highest mean detection rate occurred during nighttime (60 fish/hr) and the lowest during day periods (1 fish/hr) (Figure 2), and intermediate detections rates during dusk (4 fish/hr) and dawn (14 fish/hr) periods. However, these nighttime detection rates are also the highest detection rates we've ever observed at any intake or discharge in the last three years.

Mean fish detection rates in front of turbine intakes have steadily increased over the last four months (Figure 3). Not coincidentally, the density of kokanee in the forebay of Dworshak Reservoir has also steadily increased (see Figure 6, page 4), and in October reached the highest kokanee densities seen in three years (556 fish/acre). Increases in entrainment sampling detection rates and forebay densities also coincided with drastic increases in abundance of kokanee fry captured in our trawl sampling in the forebay from September through November, 2004. The high detection rate during nighttime suggests a high potential for substantial entrainment during this quarter.

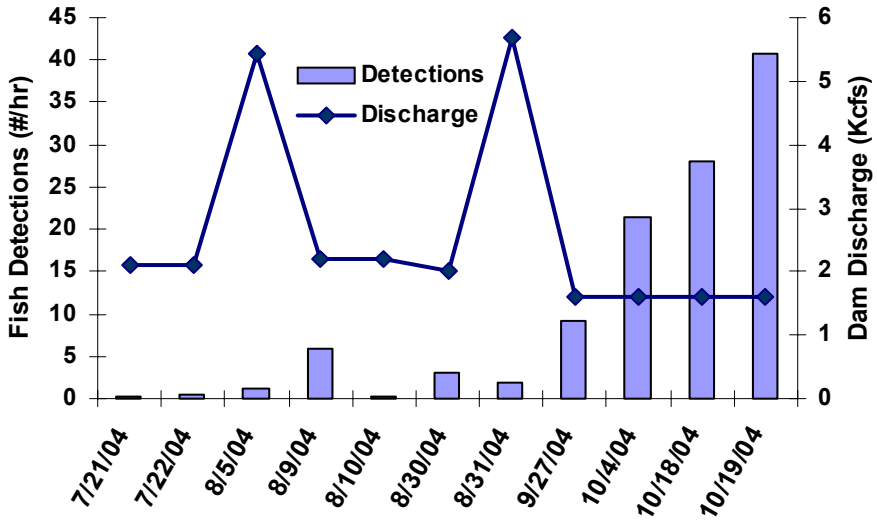


Figure 3. Mean fish detection rates (time of day periods combined) and water discharge rates (cubic feet per second x 1,000) during 24 hour entrainment assessment sampling periods, July – October, 2004.

Dworshak Quarterly Reports contain preliminary data and conclusions that are not citable.

Entrainment monitoring equipment installation

As previously discussed in several quarterly reports, we have found that our entrainment sampling could be dramatically improved by permanently installing hydroacoustic transducers inside the dam. Fixed transducers placed much closer to the actual penstock openings of each turbine would help ensure all fish targets detected with the echosounder are truly entrained. Previous entrainment assessment sampling was conducted in the reservoir forebay just upstream of turbine unit trashracks, where water velocities are low enough for fish to escape, thereby only measuring entrainment potential.

On December 6th, with the considerable help and cooperation of U.S. Army Corps of Engineers Dworshak Project personnel, BioSonics Inc. (hydroacoustic equipment company), and a contracted commercial diver, we were able to install a hydroacoustic transducer in turbine unit two of the dam (Figure 4).

The transducer was installed inside the hollow chambers between the penstock openings and the selector gates of turbine two (Figure 5). We then routed the transducer cable, which connects the transducer with the echosounder, up the concrete wall and on to the top of the dam where the echosounder is located.

This newly installed transducer will allow detection of fish as they enter the penstock to the turbine and become entrained. It will also allow us the sample entrainment much more efficiently and extensively.

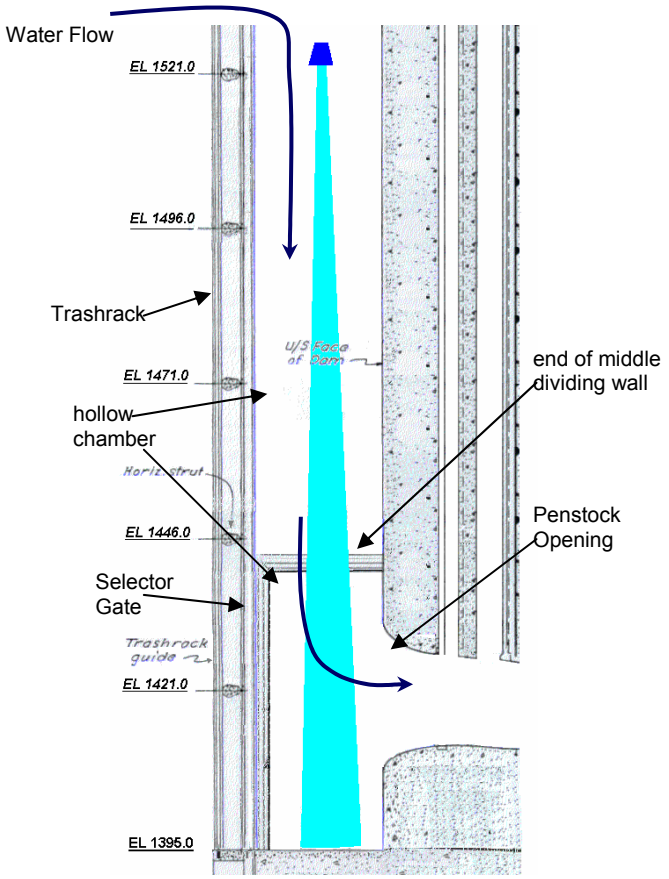
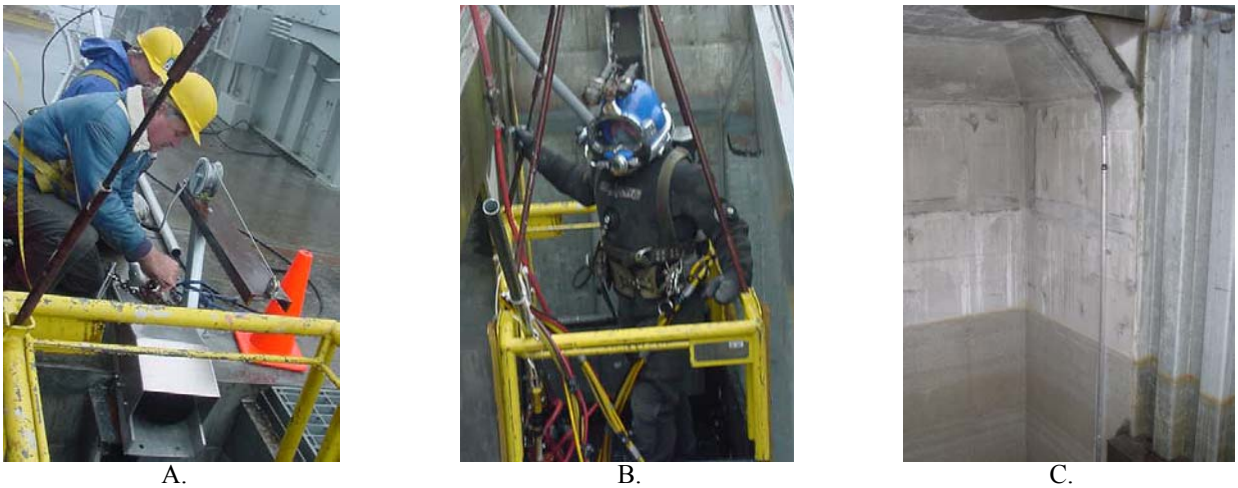


Figure 5. Sectional view of the hydroacoustic sample area inside the concrete chamber immediately upstream of the turbine 2 penstock opening.



A. B. C.

Figure 4. Photos showing steps in the installation of a hydroacoustic transducer inside turbine unit two of Dworshak Dam. A. Lowering transducer housing, cable, and conduit sections. B. Lowering diver to attach housing and conduit to concrete underwater. C. Transducer cable in conduit attached to concrete chamber running from transducer to echosounder on top of dam.

Kokanee Densities near the Dam

We continued monthly hydroacoustic surveys within the forebay area of the reservoir (near the dam), to determine the time of the year most critical for kokanee entrainment losses as well as determine when kokanee densities are high enough to feasibly test or operate strobe lights.

Fish densities near the dam were substantially higher than last year during October, November, and December (Figure 6). October densities increased to 556 fish/acre, more than 15 times higher than last October and the second highest density we've measure in the last three years (highest was 600 fish/acre in May, 2002).

Trawl sampling revealed a very abundant fry year-class comprised the majority of the increased kokanee densities in October and November.

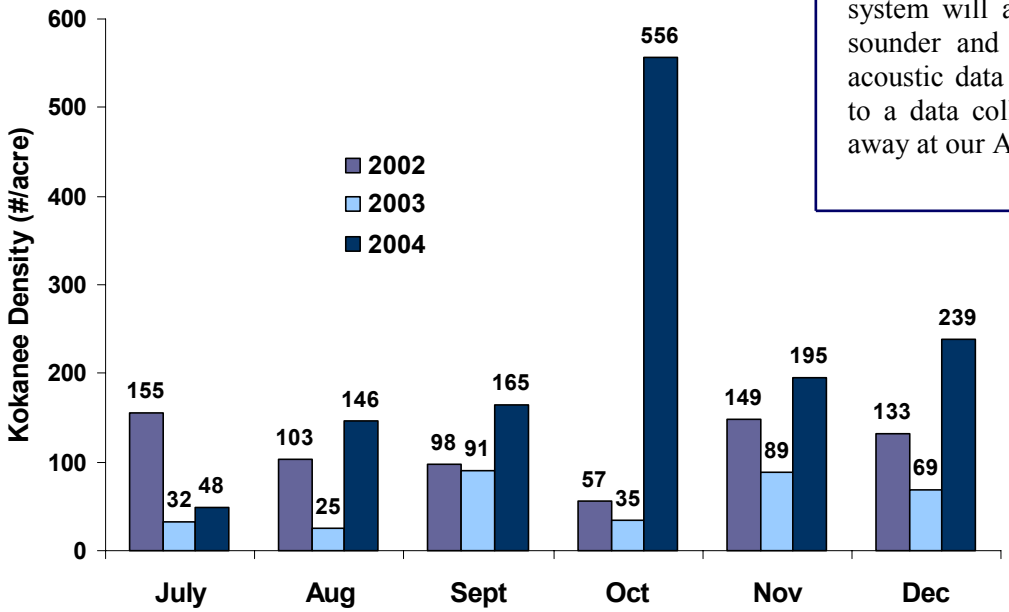


Figure 6. Average fish densities (#/acre) in the forebay of Dworshak Dam, Idaho; obtained from monthly hydroacoustic sampling, July - December, 2002 - 2004.

Next Quarter's Activities

During the next quarter, we will continue entrainment and forebay density surveys. We will finish writing the 2003 annual report and continue analysis and interpretation of entrainment echograms.

We will also be preparing a recommendation plan to permanently install underwater strobe lights as a measure to reduce fish entrainment through Dworshak Dam. This plan will be submitted to the U.S. Army Corps of Engineers, whom we're hoping will find funds and resources to implement this technology we've proven to be an effective deterrent to fish entrainment.

Lastly, we willl be installing a wireless ethernet system on Dworshak Dam. This system will allow us to control the echosounder and transducer, and transmit the acoustic data collected by the echosounder to a data collection computer over a mile away at our Ahsahka field office.

Internet Links to more info:

Are you looking for past quarterly and annual reports concerning Dworshak Reservoir research?

They can be found on Idaho Fish and Game's website at (**http://fishandgame.idaho.gov./tech/reports/**). Click on the **Fisheries** link, type '**Dworshak**' into the space to the right of the magnifying glass on the upper right of the screen, and click on the 'Go' button.

Questions and comments on Dworshak Quarterly reports should be addressed to:

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